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ALTERNATIVE MATERIAL DOWEL BARS FOR RIGID PAVEMENT JOINTS

THE NEED

Over the last thirty to forty years, dowel support of the joint in Rigid Joint Pavement (RJP) has been widely used. Because the joint dowels are at the edge of the slab, they are subject to drainage exposure of the metal to road salts and moisture. The exposure often results in corrosion of the metallic dowel itself. As the dowel must be free moving to transfer the wheel loads of traffic from one slab to the next, corrosion product can lock the dowel in place defeating its purpose. This forces the load onto the concrete itself at the slab edge resulting in excessive stresses which crack and spoil the joint edges. The cracking and deterioration of the joint eventually results in the replacement of the entire slab or the replacement of the concrete near the joint area. If corrosion damage to the dowel bar could be eliminated, pavement life could be extended with major cost savings accruing to the owner from reduced rehabilitation costs and/or replacement of the pavement.



FIGURE 1 ALTERNATIVE MATERIAL FOR COMPOSITE DOWEL BAR

THE TECHNOLOGY

The problem of deterioration of concrete pavement joints has resulted in the search for alternate solutions. Fiber-reinforced polymer (FRP) and stainless steel represent corrosion resistant alternatives to conventional galvanized steel in this application. Stainless steel have very good resistance to chlorides. This is a necessity since heavy use of road salts in the northern United States and Canada have resulted in pavement and joint deterioration. States such as Ohio, New Jersey and Pennsylvania during the 1980s and early 1990s had limited experimentation with stainless or stainless clad dowel bars. However, no fully encompassing performance analysis of the performance of these joints was done relative to alternative materials. The recently study by the FHWA of Alternative Materials for Highway Construction demonstrated the



outstanding corrosion resistance of stainless steel as compared to many other construction alternative materials such as copper, galvanized, nickel coated and epoxy coated products. Further, as this is a moving part the material used must have good abrasion resistance. Coated products run the risk of the outer corrosion resistant layer of material being worn away or otherwise damaged. The study demonstrated that even with extended wet-dry cycles of exposure to fluids of high chloride content, at various temperatures and PH levels, stainless steel had corrosion resistance hundreds and in many cases thousands of times the corrosion resistance of the alternative materials tested. The ongoing nature of the corrosion problem in highway joints and dowel bars and the recently reported results of the study has renewed interest in using stainless steel in this application.

THE BENEFITS

- High General Corrosion Resistance Chloride Resistance
- Ductility at low temperatures
- Fire and Heat resistant
- Superior Shock and Seismic Loading Resistance
- Minimum Maintenance
- Resistant to Localized Corrosion
- Mechanisms (Crevice, pitting, stress corrosion)
- Superior Strength Levels
- Ease of Storage in field
- No Special Coating Required
- Abrasion Resistant
- Long Shelf and Service Life

STATUS

Several states including Wisconsin, Iowa, Illinois, Kansas and Ohio have volunteered to put in significant runs of pavement using solid stainless bars or a dowel consisting of a welded tube (0.165 inches thick) filled with a grout center. The program will be run in conjunction with the Federal Highways Administration High Performance Concrete Program. In 1998 and 1999 installations of dowel bars have been completed in various states. Additional installations are expected in Kansas, Pennsylvania and Minnesota.

BARRIERS

- Obvious higher initial cost of stainless steel whether supplied as a solid stainless bar or a composite material with a stainless outer shell and a center of grout, concrete or carbon steel.



- Difficulty of assessment on the breath and cost of current practices: Although corrosion of the dowel and freezing of the dowel within the joint is recognized as a primary cause of joint failure and distressed joints in rigid joint pavement, there are other factors involved in many failures.

Due to the lack of data in most DOTs to make an engineering assessment of the cost of corrosion associated with the failures and subsequent repairs, it makes it difficult to present a savings figure to offset the higher initial cost of stainless. In addition the availability of composite products has not been widespread until recently and even then carbon steel centered products must be imported.

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REVIEWERS

Peer reviewed as an emerging construction technology

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